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# ASSESSMENT OF SOME HEAVY METALS IN RICE*(ORYZA SATIVA)* FIELDS IN PERLIS NORTHERN MALAYSIA

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## ABSTRACT

Three heavy metals, namely, Cd, Pb, and Ni, were assessed in five separate locations of rice cultivation fields at two soil depths. This study included most rice cultivation lands in Perlis northern Malaysia during wet season in 2014. Results showed that Cd exceeds the allowable limit in all studied sites. The ratio in site 3 is higher than that of other sites (3.97 and 4.12 mg.kg−1 soil) in the 0–15 and 15–30 cm soil depths, respectively. The results of both Pb and Ni are within allowable limit. In site (2), the highest Pb ratio (0.28 and 0.27 m.kg−1 soil) was obtained for the 0–15 and 15–30 cm soil depths, respectively. The highest Ni concentration in site 2 (3.87 m.kg−1 soil) was achieved at the 0–15 cm soil depth and in site (5) (2.34 m.kg−1 soil) at the 15–30 cm soil depth. Results showed that the values of heavy metals vary according to soil depth.

**KEYWORDS:** Malaysia, Perlis, Assessment, Cadmium, Copper, Rice

## INTRODUCTION

A continuous study on the status of heavy metals in the soil should be conducted because heavy metals in soil (whether due to natural or anthropogenic factors) can result in serious environmental and subsequent health problems. Thus, even a slight deviation in the concentration of heavy metals should be studied (Fanguiero, Bermond, et al 2002)(Sandroni, Smith, et al 2002)(Cobelo, Prego, et. al. 2003). Nwachukwu(Nwachukwu, 2008) stated that poor living environment in several developing countries is connected with lack of environmental awareness. Soil contamination occurs because of improper waste disposal (e.g., sewage and solid wastes). Irrigation and application of sewage sludge and fertilizers are designed to counter soil failure(Odukoya, Bamgbose,2007). Ibe and Njemanze(Ibe, Njemanze,1998) and Ibe and Njoku(Ibe, Njoku,1999) studied the non-metallic pollutants in the Otamiri River. According to them,pollution in thisarea was caused by poor land use and unguided human activities. The proliferation of shallow private and commercial wells (120–220 ft.) around the MVs is of great concern to public health.

The result reveals distinctly different associations among the traced metals and the major elements in urban soil. Cr concentration was affected by parent materials (natural sources), whereas Cu, Pb, and Zn were affected mainly by vehicle emissions (ZhongpingYang, Wenxi, et. al. 2011). The soil parent material and point sources of pollution had significant influences on Cr, Ni, Cu, Zn, and Cd levels; agricultural management practices were affected by microscale variations (nugget effect) of Cu and Zn pollution (Xianghua, Yongcun Zhao, et al, 2010). Environmental exposure to heavy metals is a well-known risk factor for cancers. Therefore, long-term low-dose exposure of heavy metals may play a key role in tumorigenesis, and accumulation of a high concentration of heavy metals in the human body may induce tumorigenesis(Qihong Zhao, Ying Wang, et al ,2014). Heavy metals may induce potential risks to human health if they

exceed the safethresholdsfor exposure or absorption (Man, Sun, et al, 2010)(Wei, Yang.2010)(Zhang, Zhou, et al.2011). (deVries, Romkens, 2007) asserted that the presence of heavy metals on soil can affect the quality of food, groundwater,micro-organism activity, and plant growth. The current study aimed to assess the heavy metals present in the soil of several rice fields to alert farmers that thepresence of heavy metals entails environmental risks.

## METHODOLOOGY

### Soil Sample Collection

We chose five sites for the cultivation of rice in Perlis Northern Malaysia (Table 1), which included most rice cultivation lands. Samples were taken from the upper layer with 0–15 cm depth and from the second layer with 15–30 cm depth. All samples were stored in clean brown polyethylene soil bags.

### Sample Digestion

Samples were dried at a temperature of 105 °C. Approximately 3 g of soil was digested by 10 mL of hydrochloric acid and 3.5 mL of concentrated nitric acid. The mixtures were left overnight under the switch-on fume cupboard and were heated for 2 h at 140 °C on the next day. After adding the distilled water, we filtered the mixture by using filter paper and then added up to 100 mL of distilled water (Nor WahidatulAzuraZainonNajib, SyakirahAfiza Mohammed, et al. 2012).

### Data Analysis

The concentrations of heavy metals (Cd, Pb, and Ni) in soil samples were analyzed using an atomicabsorption spectroscopy. The concentrations of heavy metals present in soil samples were compared using the maximum allowable limit (MAL) of each heavy metal.

**Table 1: Soil Sampling Sites (Agricultural Fields of Rice)**

| Sites | Name of the Site |
|---|---|
| 1 | VangBintong |
| 2 | KampungBehor Mali |
| 3 | Taman DesaPuiai |
| 4 | Arau |
| 5 | JalanUmno |

## RESULTAND DISCUSSIONS

### Depth of Soil

Results showed that the concentration of Cd differed according to soil depth. An increased Cd concentration was observed on three sites in the 15–30 cm to 0–15 cm soil depths, as shown in Figure 1. This result is consistent with (Yim, Yim, 1998), which confirmed that the ratio of Cd increases with depth. On the contrary, Figures 2 and 3 show that the concentration of Pb and Ni in all sites in the 15–30 cm to 0–15 cm soil depths decreased. The heavy metal concentration increase is higher in the 15–30 cm than in the 0–15 cm soil depth. This finding was confirmed by most previous studies, which discovered (Liu, Zhang, et al, 2007) that heavy metal concentration decreased with increasing soil depth and declined with both distance and depth because of physical dilution and increasing limits in mobility (Diana Florescu, AndreeaIordache, et al. 2011).

### Cd Accumulation

Showed the results of the analysis (Figure 1) to increase the Cd concentration allowable value in three study sites MAL according for Poland, Britain and Germany, as in the (Table 2) .While there was an increase in the concentration of cadmium In two of the study sites, but this increase was within the allowable value According to the same table for MAL. This increase has varied depending on the study sites, Where he showed the site (3) the highest Cd concentration was (3.97 and 4.12 mg. kg-1 soil ) in depths (0 - 15 cm) and (15-30 cm), respectively. while, the location (1) a lower concentration of cadmium was (1.73 and 2.02 mg. kg-1 soil ) in depths (0 - 15 cm) and (15-30 cm), respectively. This increase in Cd concentration can be attributed to the use of phosphate fertilizers and the use of herbicides excessively In the three sites which exceeded the allowable value. (Lee, Lim, et al. 2013) confirmed that Cd is released into the soil environment through the application of phosphate fertilizers. In addition,(Odukoya, Bamgbose,2007) indicated that the addition of fertilizer to address the lack of certain nutrients in the soil leads to soil contamination because of its high mobility in soil. Plants that grew on contaminated soil accumulate Cd and thus may pose serious threats to human and animal health (Sarwar, Saifullah, et al. 2010).

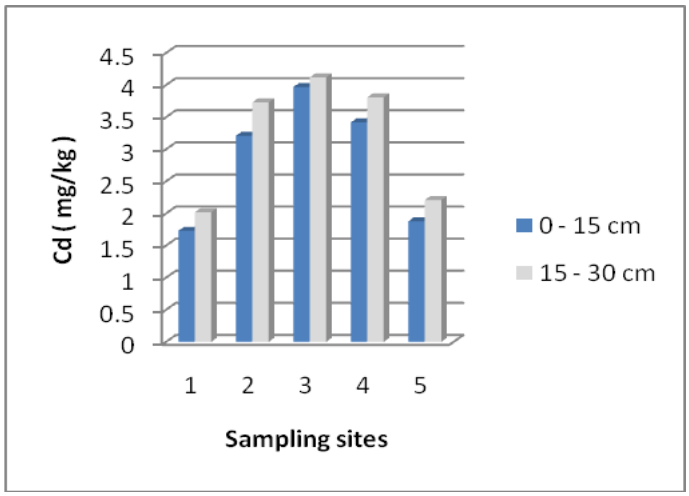


**Figure 1: The Concentration of Cadmiumin the Soilsites**

### Pb Accumulation

(Figure2) shows that the value of Pb concentration in all soil samples is very low compared with the ratio of MAL for all countries in (Table 2). This result indicates the safe level of Pb in the soil. Site (2) had the highest concentration of Pb, which reached (0.28 and 0.27 m.kg−1 soil) at (0–15 and 15–30 cm) soil depths, respectively. The Pb existing naturally in the soil or the emissions from vehicles (ZhongpingYang, Wenxi, et. al. 2011)may have caused the high Pb concentration. Low Pb concentration in sites (3) and (5) (0.24 and 0.23 m.kg−1 soil) was observed at the (0–15 and 15–30 cm) soil depths, respectively.

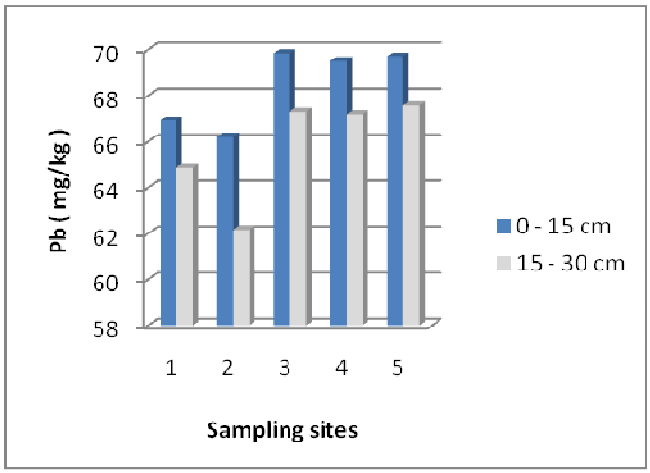


**Figure 2: The Concentration of Lead in the Soilsites**

**Ni Accumulation**

(Figure 3) shows that the Ni on all soil samples was low compared with the ratio of MAL for all countries in (Table 2). Site (2) had the highest Ni concentration, which reached (3.87 m.kg−1 soil) in the (0–15 cm) soil depth. Site (5) had the highest Ni concentration (2.34 m.kg−1 soil) at the (15–30) cm soil depth. However, site (1) showed less concentration of Ni (3.58 and 2.04 m.kg−1 soil) at the (0–15 and 15–30 cm) soil depths, respectively. This ratio is often observed in all sample soils because Ni is present in the original material and soil parent, as noted by (Xianghua, Yongcun Zhao, et al, 2010). (Banin, Novort, et al.1981) confirmed the ratio in the 0–15 cm soil depth. They also noted that Ni had the highest percentage in the 15–30 cm soil depth for all study sites because of the adsorption of clay and organic matter as well as the formation of chelating substances.

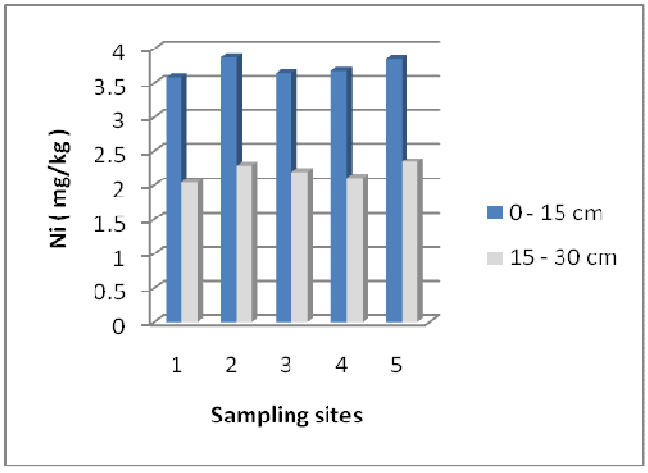


**Figure 3: The Concentration of nickelin the soilsites**

**Table 2: Values of Maximum Allowable Limits (M. A. L.) for Heavy Metals in Soil (Mg/Kg-1) Used in Different Countries**

| Chemical Element | Austria | Canada | Poland | Japan | Great Britain | Germany |
|---|---|---|---|---|---|---|
| Cd | 5 | 8 | 3 | - | 3 | 2 |
| Pb | 100 | 200 | 100 | 400 | 100 | 500 |
| Ni | 100 | 100 | 100 | 100 | 50 | 100 |

**Ref.: (**Lacatusu, 2000)

## CONCLUSIONS

Has been detected in high concentration of cadmium in some types of soil planted with rice in Perlis exceeds the allowable limit. This is probably the result of excessive use of chemical fertilizers and herbicides. Also, lead and nickel concentrations were within the allowable limits. as well as, shows the soil depth influence on heavy metal content such as cadmium in this study. So there should be more studies and searches to get rid of this dangerous problem

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